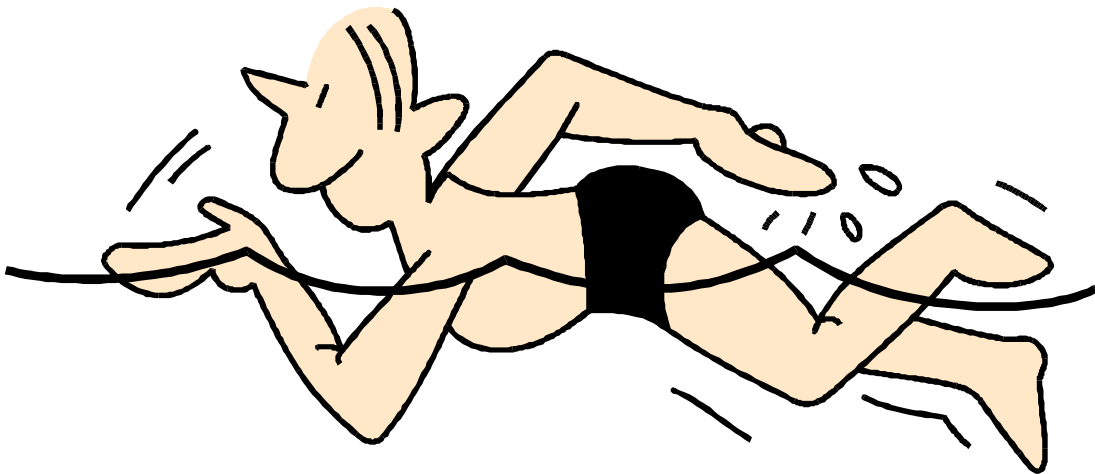


Recreational Water Quality Monitoring Project

DEVELOPING A BATHING BEACH MONITORING PROGRAM



Presented by:

Macomb County Health Department
Environmental Health Services Division

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Surface Water Quality Division
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Macomb County Health Department

Environmental Health Services Division



Program Overview

Mission: To improve the quality of life for those who live, work or play in Macomb County through the administration and enforcement of environmental public health laws; the promotion of sound environmental health practices, while maintaining an openness to emerging environmental health issues.

The value of clean, safe water for people, communities, businesses and industries is immeasurable. The Clinton River Watershed and Lake St. Clair located in southeast Michigan are significant natural resources that affect the Macomb County region geographically, economically and recreationally.

The Macomb County Health Department (MCHD) has conducted programs to protect water quality since its establishment fifty years ago and currently has several programs in the area of surface water quality monitoring and pollution prevention.

- **Surface Water Improvement and Monitoring (SWIM) Team**
Conducts monitoring, education, investigations and enforcement in order to achieve the goal of all Macomb County surface waters being in compliance with full body contact standards.
- **Bathing Beach Monitoring and Surface Water Sampling**
Monitors *E. coli* bacteria levels at public bathing beaches within the county as well as at over 60 surface water sites.
- **Environmental Management and Risk Assessment Program (EMRAP)**
Focuses on improving the management and storage of hazardous materials and responds to accidental spills and illegal dumping of hazardous wastes. EMRAP also provides a household hazardous waste collection for the proper disposal of household hazardous waste materials as well as a Clean Sweep Pesticide Program that allows for the collection of unwanted, unused, outdate and banned pesticides from end-users such as homeowners, farmers, golf courses, orchards, etc.
- **Onsite Drinking Water and Wastewater Disposal Program**
Issues permits for and regulates the installation and repair of onsite septic systems and drinking water wells. The permit process includes site evaluation, plan review and construction inspections.

I. MCHD Beach Program History

The Macomb County Health Department (MCHD) began monitoring bathing beaches in 1948. At that time, four beaches were monitored for total coliform bacteria. Other than the addition of several beach sites, the program continued relatively unchanged until 1967 when Michigan Public Act 218 was promulgated, which established fecal coliform bacteria as the standard indicator bacteria group for determining bathing water quality. At this time, the Department began analyzing samples for fecal coliform and continued until 1995 when the indicator was again changed to the yet more specific organism, *Escherichia coli* or *E. coli*. Act 218 was incorporated as Part 125 into the Michigan Public Health Code in 1978.

Over the years of the program's evolution, beach closings occurred intermittently on Lake St. Clair and in other areas. However, in 1994 the beaches were closed for much of the summer on Lake St. Clair and in several inland areas due to elevated bacteria levels. The problem has continued to varying degrees since 1994 and has had many social, economic and environmental ramifications.

In 1990, to augment the bathing beach monitoring program, the Macomb County Health Department foresaw the need to begin collecting data on bacteria levels in tributaries of the Clinton River Watershed and other minor watersheds. The purpose of this monitoring was to establish background levels of bacteria and evaluate impacts of sources of sewage pollution in the county. The data collected is distributed to other interested agencies and is a critical part of MCHD's Surface Water Improvement and Monitoring (SWIM) Team efforts.

In 1998, the MCHD began conducting an annual water quality assessment of Lake St. Clair with support from the Macomb County Board of Commissioners, the Michigan Department of Environmental Quality and the United States Army Corps of Engineers. The purpose of this monitoring is to evaluate environmental stresses, ascertain the amount and distribution of pollutants and to establish a water quality benchmark of Lake St. Clair. This effort was also conducted in 1999 and 2000 and is planned again for 2001.

II. Why Monitor Bathing Beaches?

The MCHD has chosen to monitor bathing beaches to assure a safe and healthy recreational experience for the people who visit Macomb County beaches. Ensuring safe beaches is also beneficial to the area's economy.

Beach water samples are analyzed for *Escherichia Coli* (*E. coli*), which, in high numbers indicate that surface water contamination by sewage or other wastewater has occurred and that harmful bacteria may be present. Bathing beach monitoring programs help protect public health by managing the risk associated with swimming in open waters.

III. Water Quality Standards

The Michigan Public Health Code, P.A. 368 of 1978 authorizes local health departments to monitor and evaluate water quality at public bathing beaches and to determine whether the water is safe for bathing purposes. This act also sets standards that limit the levels of *E. coli* at beaches called Total Body Contact Standards. A bathing beach is closed whenever these standards are exceeded. See Appendix A.

The Total Body Contact Standards are:

- A. *Daily Geometric Mean* - The geometric mean of 3 or more samples taken during the same sampling event at representative locations within a defined sample area. This shall not exceed 300 *E. coli* per 100 milliliters.
- B. *30-Day Geometric Mean* - The geometric mean of all individual samples collected during 5 or more sampling events representatively taken over a 30-day period. This shall not exceed 130 *E. coli* per 100 milliliters.

A sampling event consists of 3 or more samples taken at representative locations within a designated sampling area along the bathing beach.

The Great Lakes-Upper Mississippi River Board of State Sanitary Engineers, in 1972, created a Standards Committee on Swimming Pools and Bathing Beaches consisting of one associate from each state represented on the Board. The Committee was assigned the task of developing physical, chemical and bacteriological standards for bathing beaches. The standards were first adopted in 1975 and revised in 1990. The document is titled "Recommended Standards for Bathing Beaches" and is intended to serve as a guideline for the design, operation and use of public bathing beaches. This document is especially useful in the development of a beach monitoring program. Please note that the bacterial standards contained in this document differ from the State of Michigan Standards.

IV. Why *E. coli* bacteria?

As A Water Quality Standard

Water quality standards define a measurable relationship between the quantity of the indicator in the water and the potential risk to human health associated with using the water for recreational purposes. Swimming in water with bacteria levels in compliance with water quality standards does not eliminate the risk of illness. Nor does swimming in water not in compliance with standards indicate absolute illness.

Current guidelines established by the US EPA result from studies conducted at marine and freshwater beaches in the late 1970's and 1980's. In 1986, the US EPA recommended that *E. coli* be used as an indicator of fecal contamination in recreational waters. The standard was set at a geometric mean concentration of 126 colonies per 100 milliliters (mL) of water, which was estimated to be correlated with a gastrointestinal illness rate of about 8 individuals per 1,000 swimmers.

Swimmers and non-swimmers were interviewed at freshwater bathing beaches on Lake Erie in Pennsylvania and on Keystone Lake near Tulsa, Oklahoma. Swimming was strictly defined as activity which resulted in all upper body openings being exposed to the water. The beaches had different levels of fecal indicator bacteria. After 8 to 10 days, the swimmers and non-swimmers were interviewed again with regard to symptoms of gastrointestinal or respiratory illness. The prevalence of gastrointestinal or respiratory illness was then compared to the concentrations of *E. coli*, enterococci and fecal coliforms on the day of swimming, as well as, between swimmers and non-swimmers. The conclusion of this study was that *E. coli* and enterococci showed the strongest relationship with swimming-associated gastrointestinal illness, but fecal coliform densities showed little or no relation to gastrointestinal illness in swimmers.

This study serves as a reminder that it is not a simple task to arrive at recreational water quality standards. No single test is infallible or correct for every situation. Individuals use recreational waters in different ways, and are not equally susceptible to disease due to their situation. Not every swimmer in these studies suffered gastrointestinal illness.

As An Indicator of the Presence of Sewage/Wastewater

E. coli bacteria is a naturally occurring bacteria that live in the digestive tract of warm blooded animals, including humans and as such, serve as an indicator of potential bacterial pathogen contamination. It is generally much simpler, quicker and safer to analyze for an indicator organism than for the individual pathogens that may be present. The presence of *E. coli* bacteria in surface water indicates pollution from sewage and wastewater and the potential for other pathogens to be present.

Sources of *E. Coli* Bacteria

- **Combined sewer overflows (CSOs)** – A combined sewer is a sewer that is designed to carry both sanitary sewage and storm water runoff. A discharge from a combined sewer system occurs in response to rainfall and/or snowmelt because the carrying capacity of the sewer system is exceeded. These discharges do not receive all the treatment that is available and utilized under ordinary dry weather conditions. Normally, wastewater is transported to a wastewater treatment facility where it receives appropriate treatment prior to discharge. CSOs usually occur under very wet weather conditions and are diluted with storm water.
- **Sanitary sewer overflows (SSOs)** – SSOs are discharges of raw or inadequately treated sewage from municipal separate sanitary sewer systems. These systems are designed to carry sanitary sewage but not storm water. SSOs often constitute a serious environmental and public health threat. Most SSOs are associated with wet weather conditions when sanitary sewers receive inflow and infiltration from groundwater. Problems that may cause chronic SSOs include: too much infiltration and inflow from groundwater through cracks in sewer pipes; rainwater or snow melt flowing into the system through roof drain connections; groundwater from footing drains with house leads connected to the sanitary system; under designed systems; system failures due to tree roots growing into the sewer; sections of sewer pipe settling or shifting; sediment causing blockages; equipment and pump failures and power failures.
- **Illegal connections** – Illegal connections include such things as wastewater plumbing incorrectly connected to storm drains and/or ditches instead of being connected to onsite sewage disposal systems (OSDS) or sanitary sewers.
- **Urban and agricultural runoff** – Rainwater or snowmelt that runs over various landscapes picks up a variety of pollutants and deposits them into nearby waterways impacting water quality. Pollutants include: soil, fertilizers, pesticides, animal waste, road salt, motor oil, etc.
- **Malfunctioning onsite sewage disposal systems** – A septic system that does not function properly can be a health hazard because sewage may contain harmful bacteria and viruses. It can be a nuisance as sewage on the ground surface may cause property damage and offensive odors. It can also result in the discharge of sewage into nearby waterways potentially impairing water quality and causing beach closings.
- **Wild and domestic animal waste** – *E. coli* bacteria is a naturally occurring bacteria that live in the digestive tract of warm blooded animals. Improper management of animal waste, particularly domestic pet waste, can be a source of bacteria in recreational waters.

V. Developing A Beach Monitoring Program

The following is a list of recommended steps provided to assist in the development of a beach monitoring program.

Initial Beach Survey

Plan a site visit to each public bathing beach to conduct a physical survey and identify the sampling area. Solicit the involvement of the respective beach operators in the physical survey and identification process.

A. Measurements and Landmarks

Take measurements and define the dimensions of the swimming area. Identify landmarks as reference points. Use the measurements and landmarks to identify specific sample locations and for future consistency in sample collection. Create a map of the bathing beach, include distances measured, landmarks and established sampling sites. Assign a reference number to each sample site.

Example: Metropolitan Beach in Harrison Township has 902 feet of water frontage. Six (6) samples, numbered 1.1 through 1.6, are representatively spread out over the water frontage. The lifeguard station is the main landmark. Sample sites are identified using measurements from this station to the east and west, as well as, by using lifeguard chairs as reference points. (See Appendix B)

B. Physical Conditions

During the initial beach survey, it is imperative to identify potential hazards that may be encountered during sample collection. Wade in the water to survey the actual sample sites. Note hazardous conditions such as sink holes, drop-offs, aeration equipment, rocky areas, etc.

C. Beach Access

Observe how and where staff will be able to access the beach and its sampling sites, especially during restricted hours. Observe parking areas and applicable walking distances. This is useful in planning the time required for sample collection and making routing decisions.

D. Sanitary Survey

Section 3.0 of the “Recommended Standards for Bathing Beaches” document recommends that the regulating agency (e.g. local health departments) conduct a sanitary survey of each beach on an annual basis. The survey includes: identifying potential sources of contamination, weather and topographical influences, existing water quality in terms of bacteria, pH level and turbidity, as well as, other important physical characteristics of the bathing beach. The sanitary survey is described in the “Recommended Standards for Bathing Beaches” document.

Sampling Program

A. Sample Routes

Identify the number of bathing beaches to be sampled and their physical locations. Identify parking locations at each beach and how to obtain access to the beach if it is restricted at any time. Make note of walking distances to sample sites and driving distances between beach locations. These factors are necessary considerations to establishing sampling routes. Identify the number of samples to be collected at each beach and any additional watershed samples that will be collected. Keep in mind that the State of Michigan recommends a minimum of 3 samples per beach per sampling event.

Example: The MCHD monitors six bathing beaches split into two sampling routes. One sampling route consists of the three inland beaches (Stony Creek Baypoint, Stony Creek Eastwood and Four Bears Water Park). The second sampling route includes the four Lake St. Clair beaches (St. Clair Shores Memorial, St. Clair Shores Blossom Heath, Metropolitan Beach, New Baltimore Beach) plus two tactical watershed sampling sites at the mouth of the Clinton River and Clinton River Spillway. These watershed sample sites are in close proximity to two of the lake beaches.

B. Staffing

Adequate staff will be required to conduct a sampling program and may consist of full-time professional staff and/or temporary employees/summer interns. The staff requirements will be dependent on the number of beaches being monitored, routing conditions and distances between beaches.

Example: The MCHD utilizes two (2) full time staff and/or contractual employees for beach water sample collection. An additional staff member is utilized once per month during the beach season to assist with beach sediment sampling on the four beaches located along Lake St. Clair. The MCHD beach sediment sampling is part of a lake assessment grant program.

Beach sample collection is conducted on a rotating staff basis. There are a total of five (5) full time staff members who are trained in the beach sampling program in addition to any contractual/summer employees hired for that purpose. A staff member is assigned, either permanently or on a rotating basis, to complete beach monitoring paper work in the office (entering data, preparing beach operator reports, compiling opening or closing letters, and updating the Internet beach information).

C. Equipment

The following is a list of equipment that is utilized by the MCHD for beach water sampling.

- **Cooler with ice packs** – *to maintain water temperature of samples collected*
- **Thermometer** – *to record temperature of water body*
- **100 mL sampling bottles** – *to ensure samples with adequate water volume; consult laboratory for appropriate bottles*
- **Sampling wand** – *used to collect samples away from body of sampler to avoid sediment contamination*
- **Waders** – *allows sampler to collect water from adequate water depth*
- **Beach sample site map** – *used as reference for accurate sample locations*
- **Blank data sheet** - *to record sample time, water temperatures & wind direction in the field; See Appendix C*
- **Water quality meter** - *optional; to record additional water quality parameters including turbidity, conductivity, dissolved oxygen*
- **Personal safety/hygiene equipment** *2-way radio, gloves, safety vest, hand wipes or hand sanitizers*

D. Preparation

All necessary equipment should be gathered and organized at least one workday prior to the day of water sampling.

Assign a number to each bathing beach for sampling purposes. Sample collection bottles should be labeled with the sample number and site number and/or name. It's helpful to label sample bottles in the office instead of in the field. This helps prevent a shortage of sample bottles, illegible labeling and missed samples.

E. Sample Collection

Establish a sampling plan to ensure beach sampling is consistent and is conducted at regular intervals.

Be certain to collect a minimum of 100mL of water at each sample site to provide sufficient volume for testing and analysis. The best manner in which to collect beach samples is by wading into the water to a depth that allows collection in 3 – 6 feet of water and collecting samples by hand using a sampling wand one foot below the surface. (The use of a boat in some instances may be desirable, particularly if you are collecting samples from multiple beaches along the same shoreline which are in close proximity.) *The Great Lakes-Upper Mississippi River Board of State Sanitary Engineers Recommended Standards for Bathing Beaches document states that samples should be collected within one foot of the surface in water three to six feet deep.*

Each sampling event should consist of 3 or more samples collected at representative locations within a designated sampling area. Also, be certain that at least 5 sampling events occur representatively over a 30-day period. It is recommended sampling begin at least 30 days prior to the opening of the beach. A minimum of 30-days of data is required to comply with water quality standards. *The Michigan Public Health Code, P.A. 368 of 1978 sets the standards for sample quantity and frequency.*

Example: The MCHD monitors seven public bathing beaches. Samples are collected twice weekly from April through September. Three samples are collected at six of our seven beaches during each sampling event. Six samples are collected at Metropolitan Beach due to its large size. Samples are collected from predetermined locations, one foot below the surface, in water three to six feet deep using a hand-held sampling wand.

Other Considerations:

- Exercise caution to not stir sediment when entering water. Use a hand-held sampling wand to reach out away from body to obtain sample.
- Exercise caution to prevent cross contamination (avoid touching the rim of the bottle and inside cap while collecting the sample).
- Exercise caution when collecting samples from water with high waves. Personal safety is the first priority. Samples may not be able to be collected from the same depth during periods of high waves.
- To preserve the integrity of the water samples, return them promptly to a cooler containing ice packs.

Laboratory Analysis

The Michigan Public Health Code states that bacterial concentrations in water at a bathing beach should be determined by following the document entitled “Standard Methods for the Examination of Water and Wastewater, 20th Edition – 1998”. This document is published by the American Public Health Association, the American Water Works Association and the Water Environment Federation.

Some of the considerations in selecting laboratory analysis methods include:

- **Sample analysis lag time** – All of the currently approved analysis methods require an extended period of time between sample collection and reporting of results, generally 18 – 28 hours. Obviously, this is not ideal. If bacterial numbers are high, the public continues to be exposed until the beach can be closed. Collecting the samples as early in the day as possible will allow reporting of the results early on the following day and any closures can be ordered before beaches get crowded. Also, be prepared to discuss this issue with the news media.

- **Sample analysis hold time** – This refers to the amount of time a sample can be held after collection, before being delivered to the laboratory. Analysis methods with longer hold times are generally best.
- **Collection schedule** – Samples should be collected early enough in the week to provide ample time for closures and/or follow-up samples prior to weekends. Generally, Mondays, Tuesdays and Wednesdays are the best days for sample collection.
- **Communication with the laboratory** – Make sure laboratory personnel are aware of sampling schedules and notify them any time non-routine or extra samples are anticipated.

Example: The water samples collected by MCHD are analyzed at the State Certified Martha T. Berry Medical Care Facility in Mt. Clemens. The lab utilizes the Idexx Colilert System for sample analysis. Water samples must be returned within 24 hours of collection but are normally returned to the laboratory for analysis within 6 hours of collection. Testing and determination of bacterial concentrations can be conducted in 24 hours, with an 18 hour testing procedure also available. The MCHD collects beach water samples on Monday and Wednesday mornings. Sample results are received on Tuesday and Thursday afternoons and then water quality determinations are made.

VI. Database Maintenance

It is vital to maintain records of the samples collected and the testing results that have been reported in an organized manner. A database is the tool used to maintain these records. The database can be a manual ledger or a computerized format utilizing a database program or spreadsheet software. See Appendix D.

The following information should be included in your database for each sampling event.

- Sample collection date
- Collection time
- Water temperature
- Wind direction
- Last rainfall date (and amount)
- Bacterial concentration results for each sample collected

Tracking this information may be useful in linking bacterial levels to beach closings and weather conditions.

Statistical Calculations

The following statistical calculations will need to be performed, either using a formula from the database or calculated manually. These calculations are needed to make comparisons to state water quality standards.

- Daily Geometric Mean of 3 or more samples collected during the same sampling event at representative locations within a defined bathing and sampling area.
- 30-Day Geometric Mean of all individual samples taken during 5 or more sampling events representatively spread over a 30-day period

Example: The MCHD currently uses a database that was created from MS Access as its background operating system. Previously, our data was entered into a spreadsheet database using a Lotus 123 application. Prior to that, all records were kept manually.

Considerations:

- Consult with a representative of your organization's MIS department for software information.
- Keep in mind the need to perform statistical calculations.
- Be aware that you may need to defend and/or explain how water quality numbers were calculated or presented.

Example: The MCHD created two documents used to identify, compare and notify beach operators of their respective water quality results. Each bathing beach has a Beach Summary Page that includes the following sample information: date, time, daily and 30-day bacterial geometric mean, water temperature, wind direction and the last rain date. The Beach Operator Page, specific to the bathing beach, is a document that contains the sample date, as well as, the daily and 30-day bacterial geometric means. The Beach Operator Page identifies whether or not the bathing beach is in compliance with water quality standards and what standard is exceeded for non-compliance. This document is send via facsimile to each beach operator after the results of each sampling event are received.

Beach Operator Notification

Notify the beach operators of their respective water sample results as soon as possible after the information is entered into the database and all necessary calculations have been performed and verified.

The following is a list of recommended materials that may be useful in the notification process:

- **Contact list** – Prepare a master list that includes the beach name, beach operator, telephone, address and fax information.
- **Bathing Beach Summary Report** – Summary page containing dates of samples collected and both the daily and 30-day geometric means. See Appendix E.
- **Beach Opening and Closing letters** – Design a document containing the current date, beach operator information and water quality results. A computerized format will provide for easy calculation/presentation of the information. See Appendices F, G.
- **File Maintenance** – Maintain paper (hard) copies of results, letters and other appropriate documents in addition to computer records for each of the beaches being monitored. See Appendix H.

The following is a list of recommended steps that prove useful in the beach operator notification process:

- **Telephone contact** – An authorized representative of the local health department should make contact with each beach operator to report the bacterial results from the previous day's sampling. Be prepared to discuss results and further sampling options.
- **Fax transmittals** – Telephone contact should be followed up with a hard copy of the results and the applicable closing/opening letter via fax.
- **Web page posting** – (If applicable) Beach sampling results may be posted on the Internet after the information is entered into the database. It is recommended that this information be updated after each beach sampling event. See Appendix I.

Example: The MCHD web page is updated twice weekly on Tuesday and Thursday afternoons and on Saturday as needed, if contingency sampling occurred on Friday.
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- **Public notification via radio and or television** – This can be conducted using a regularly updated press release or by responding to individual media contacts. Media contacts may become familiar with sampling schedules and may obtain much of the necessary information from a web page.
- **Official copies of results provided** – Each beach operator should receive an official hard copy of the results and/or appropriate letter via U.S. Mail.

VII. Contingency Sampling Procedures

These are identified procedures that would be implemented in the event of beach closings. The procedures would outline when, why and how additional beach samples are to be taken and under what circumstances. Contingency sampling procedures are in place to ensure that additional sampling in the event of a closure, will not further delay the reopening of a beach. If levels of *E. coli* have been increasing, additional sampling could result in a prolonged closing.

Example: The MCHD has a contingency sampling procedure (see Appendix J) which states that under certain conditions an additional sampling event will be conducted on Fridays to determine if a closed beach can reopen. These conditions are as follows:

- Water quality at a particular beach is in non-compliance with the daily geometric mean but is in compliance with the 30-day geometric mean based on the Wednesday sampling event.
- Water quality at the beach is in non-compliance with the 30-day geometric mean, but the two previous consecutive sample events indicate daily geometric means less than 130 and an additional sample event would have the potential to lower the 30-day geometric mean into compliance.

VIII. Future Considerations

Expanded Monitoring Efforts

- ***Water Quality Assessment*** – An enhanced water sampling project conducted over a period of time in order to achieve specific water quality goals and objectives. The Lake St. Clair Water Quality Assessment Project conducted in Macomb County has the following outcomes: establish a water quality benchmark; better characterize the impact of CSOs and retention basin discharges on water quality; provide an increased understanding of the relationship between sediments and water quality.
- ***Wet Weather Beach Testing*** – Additional sampling conducted during periods of wet weather conditions to identify trends in bacterial levels, wet weather, beach closings and the occurrence of SSOs and/or CSOs. For additional testing, it is necessary to establish a definition of wet weather and identify a threshold of precipitation for which sampling is to occur.
- ***Strategic Watershed Samples or Drain Samples*** – Collecting water samples from identified locations on rivers, lakes, tributaries and drains. Identify significant sampling locations (e.g. receiving waters of CSOs and tributaries) in close proximity to beaches. Prior to establishing a strategic sampling program, consider how the collected data will be utilized.

Preemptive Beach Closings

Consider implementing measures to close bathing beaches in response to heavy precipitation or known CSO/SSO events. This is a way of preventing exposure of the public when contamination may be present and sample results are not immediately available. The Michigan Public Health Code gives authority to local health officers to take necessary precautions to protect public health from potential health threats.

Illness Complaint Log for Bathing Beaches

Consider maintaining a complaint log that registers illnesses reported as they relate to swimming at public bathing beaches. This information can be compared to trends in bacterial concentrations, beach closings and occurrence of events such as CSOs and SSOs.

Future Testing Methods

- ***Rapid Testing*** - There is a need to have the ability to determine bacterial levels in recreational waters more rapidly than the methods that currently exist. Such testing should be fast and reliable and have the ability to be performed onsite if needed. Several possible methods are under development:
 - **Bioluminescence** – Bacterial numbers are directly proportional to the intensity of light emitted when cell ATP (Adenosine triphosphate) is reacted with luciferase.
 - **Flow Cytometry** – Bacterial cells are marked with labeled antibodies that bend a laser beam. Each bending of the laser is counted as one cell.
 - **Fiber optics and DNA/RNA technology**
- ***Caffeine Testing*** - Caffeine is a relatively unnatural molecule in our environment. It is found in certain edible products such as chocolate and coffee. Water samples can be analyzed for caffeine content and therefore, caffeine could serve as an indicator of human effluent. Caffeine does not degrade quickly so timing of sample analysis is not as critical.
- ***DNA-Source Identification*** – Methods are being developed to permit the differentiation of *E. coli* between humans and animals by identifying the structure of the DNA inside the bacteria cell. This would allow sources of bacterial pollution to be further isolated.
- ***Development of Predictive Models*** – This refers to the development of models that can predict the occurrence of high bacterial counts and allow beaches to be closed before exposure of the public can occur. Such models can predict the levels of bacteria in relation to precipitation, wind direction, wave height and water currents. An important requirement is that ample data is gathered to establish the model and guarantee its accuracy.

IX. Obtaining Additional Information

Federal Government

- Army Corps of Engineers (USACE) <http://www.usace.army.mil/>
- Department of Agriculture (USDA) <http://www.usda.gov/>
- Natural Resources Conservation Service <http://www.nrcs.usda.gov/>
- U.S. Department of the Interior Geological Survey (USGS) <http://www.usgs.gov/>
- Environmental Protection Agency (USEPA) <http://www.epa.gov/>
- National Oceanic and Atmospheric Administration (NOAA) <http://www.noaa.gov/>
- National Weather Service <http://www.nws.noaa.gov/>

Michigan State Government

- Department of Agriculture <http://www.mda.state.mi.us/>
- Department of Environmental Quality (DEQ) <http://www.deq.state.mi.us/>
 - Environmental Assistance Division <http://www.deq.state.mi.us/ead>
 - Environmental Education <http://www.deq.state.mi.us/enved>
 - Land and Water Management <http://www.deq.state.mi.us/lwm>
 - Surface Water Quality <http://www.deq.state.mi.us/swq>
- Department of Natural Resources (DNR) <http://www.dnr.state.mi.us/>
- State of Michigan http://www.state.mi.us/index_ie.htm

County Government

- Macomb County Health Department <http://www.libcoop.net/mchd/>
- Michigan Association of Counties <http://www.miaco.org/>

Non-Profit Organizations

- Clinton River Watershed Council <http://www.crwcc.org/>
- Friends of the Rouge <http://www.therouge.org/>
- Great Lakes Commission (GLC) <http://www.glc.org/>
- Natural Resources Defense Council <http://www.nrdc.org/water/oceans/ttn/titinx.asp/>
- South Eastern Michigan Council of Governments (SEMCOG) <http://www.semco.org/>
- Center for Watershed Protection <http://www.cwp.org/>

Academic Institutions

- Central Michigan University <http://www.cmich.edu/>
- Eastern Michigan University <http://www.emich.edu/>
- Michigan State University <http://www.msu.edu/>
- Michigan Technological University <http://www.mtu.edu/>
- Northern Michigan University <http://www.nmu.edu/>
- University of Michigan <http://www.umich.edu/>
- Wayne State University <http://www.wayne.edu/>

To Obtain A Copy of the Document “Recommended Standards for Bathing Beaches”

Contact: Health Education Services P.O. Box 7126 Albany, N.Y. 12224

Telephone: (518) 439-7286

X. Glossary

Coliform	Group of bacteria species displaying common characteristics that are found in fecal matter, soil, vegetation and other matter.
Conductivity	A measure of the ability of an aqueous solution to carry an electric current. This ability depends on the presence of ions; on their total concentration, mobility and valence; and on the temperature of measurement. Solutions of most inorganic compounds are relatively good conductors. Conversely, molecules of organic compounds that do not dissociate in aqueous solution conduct a current very poorly.
Dissolved Oxygen	A direct measurement of the amount of oxygen in the system available to support aquatic life. Levels above 7 mg/L are desirable; levels below 5 mg/L are considered problematic; levels below 2 mg/L are lethal to many aquatic organisms.
<i>E. coli</i>	Abbreviation for <i>Escherichia coli</i> , a species of fecal coliform bacteria found in fecal matter of humans and other warm-blooded animals. Its presence in surface water indicates that contamination by sewage or other wastewater has occurred.
Fecal Coliform	Those species of coliform bacteria found in fecal material.
Geometric Mean	The nth root of the product of a series of sample results where n equals the number of results.
MCHD	Macomb County Health Department
MDEQ	Michigan Department of Environmental Quality
PH Level	The pH of water refers to a measurement of the hydrogen-ion concentration. An excessive concentration of hydrogen ions may adversely affect water for one or more beneficial uses, pH is a measure of a potential pollutant.
Turbidity	A measurement of the extent to which light is diffracted and absorbed in a lake, measured in Nephelometric Turbidity Units (NTU). The level of suspended solids in the water column is directly related to turbidity.
Total Coliform	All species of coliform bacteria.
US EPA	United States Environmental Protection Agency

XI. List of Appendices

- Appendix A ***Michigan Public Health Code***
- Appendix B ***Metro Beach Sample Point Measurements***
- Appendix C ***Beach Sampling Laboratory Results Form***
- Appendix D ***MCHD Beach Sampling Data for Metropolitan Beach***
- Appendix E ***MCHD Beach Sampling Program E. coli Results***
- Appendix F ***Bathing Beach Closing Letter***
- Appendix G ***Bathing Beach Opening Letter***
- Appendix H ***Macomb County Bathing Beach Closure Dates***
- Appendix I ***Macomb County Health Department Web Page***
- Appendix J ***MCHD Contingency Sampling Procedures***

BUREAU OF ENVIRONMENTAL AND OCCUPATIONAL HEALTH

PUBLIC BATHING BEACHES

By authority conferred on the director of public health by section 12544 of Act No. 368 of the Public Acts of 1978, as amended, being 333.12544 of the Michigan Compiled Laws.

R 325.2101, R325.2101 and R 325.2103 of the Michigan Administrative Code, appearing on pages 1893 and 1894 of the 1979 Michigan Administrative Code, are amended to read as follows:

R325.2101 Definitions.

Rule 1. (1) “Act” means sections 12541 to 12546 of Act No. 368 of the Public Acts of 1978, as amended, being 333.12541 to 333.12546 of the Michigan Compiled Laws.

- (2) “Bathing beach” means a beach or swimming area offered to the public for recreational bathing or swimming. It does not include a swimming pool as defined in section 12521 of Act No. 368 of the Public Acts of 1978, as amended, being 333.12521 of the Michigan Compiled Laws.
- (3) “Escherichia coli” or “E. coli” means a bacteria which is a member of the family enterobacteriaceae and which is the predominant facultative anaerobe in humans and warm-blooded animals. Therefore, it is an indicator of the presence of human or animal fecal material in water. The organism is identified by a variety of laboratory methods with definitive identifying characteristics described by Bergey’s Manual of Bacteriology (Williams and Wilkins, 9th Edition, 1994.)
- (4) “Geometric Mean” means the antilog of the summation of the logarithms of the values for the samples examined divided by the number of samples.
- (5) “Health Officer” means the administrative officer of a city, county or district health department.
- (6) “Sanitary or environmental survey” means and includes all of the following:
 - (a) A survey and an evaluation of data of the applicable contributory watershed for pollution, including domestic, industrial, commercial and agricultural sources.
 - (b) A survey and an evaluation of data of the bathing beach for sources of pollution and safety hazards, including soil conditions, drop-offs, water movement and submerged and other hazardous objects.
 - (c) Water depth in diving areas.
 - (d) An evaluation of proposed or existing bathing and swimming loads.
- (7) “Standard methods” means the publication entitled Standard Methods for the Examination of Water and Wastewater, 18th Edition – 1992, as published by the American Public Health Association, the American Water Works Association, and the Water Environment Federation. This publication is adopted by reference in these rules and is on file and available for inspection in the Bureau of Environmental and Occupational Health, Michigan Department of Public Health, 3423 North Martin Luther King Jr. Blvd., Lansing, MI. Copies are available from the American Public Health Association, 1015 Fifteenth Street, N.W., Washington, D.C. 20005.

R325.2102 Sanitation and safety determinations.

Rule 2. (1) Bacterial concentrations in water at a bathing beach, as determined by standard methods, shall contain not more than 130 Escherichia coli (E. coli) per 100 milliliters, as a 30-day geometric mean. Compliance shall be based on the geometric mean of all individual samples taken during 5 or more sampling events representatively spread over a 30-day period. Each sampling event shall consist of 3 or more samples taken at representative locations within a designated sampling area. Bathing beach waters shall not contain more than a maximum of 300 E. coli per 100 milliliters. Compliance shall be based on the geometric mean of 3 or more samples taken during the same sampling event at representative locations within a defined sampling area.

(2) Chemical determinations shall follow standard methods and shall show that the water is free of chemical substances capable of creating toxic reactions or irritations to the skin or membranes of a bather or swimmer.

(3) Physical determinations shall show the water to be free of all of the following:

- (a) Turbidity
- (b) Color
- (c) Deposits
- (d) Growths
- (e) Oils
- (f) Greases
- (g) Any other substances in the water capable of creating a health or safety hazard or a nuisance to a bather or swimmer.

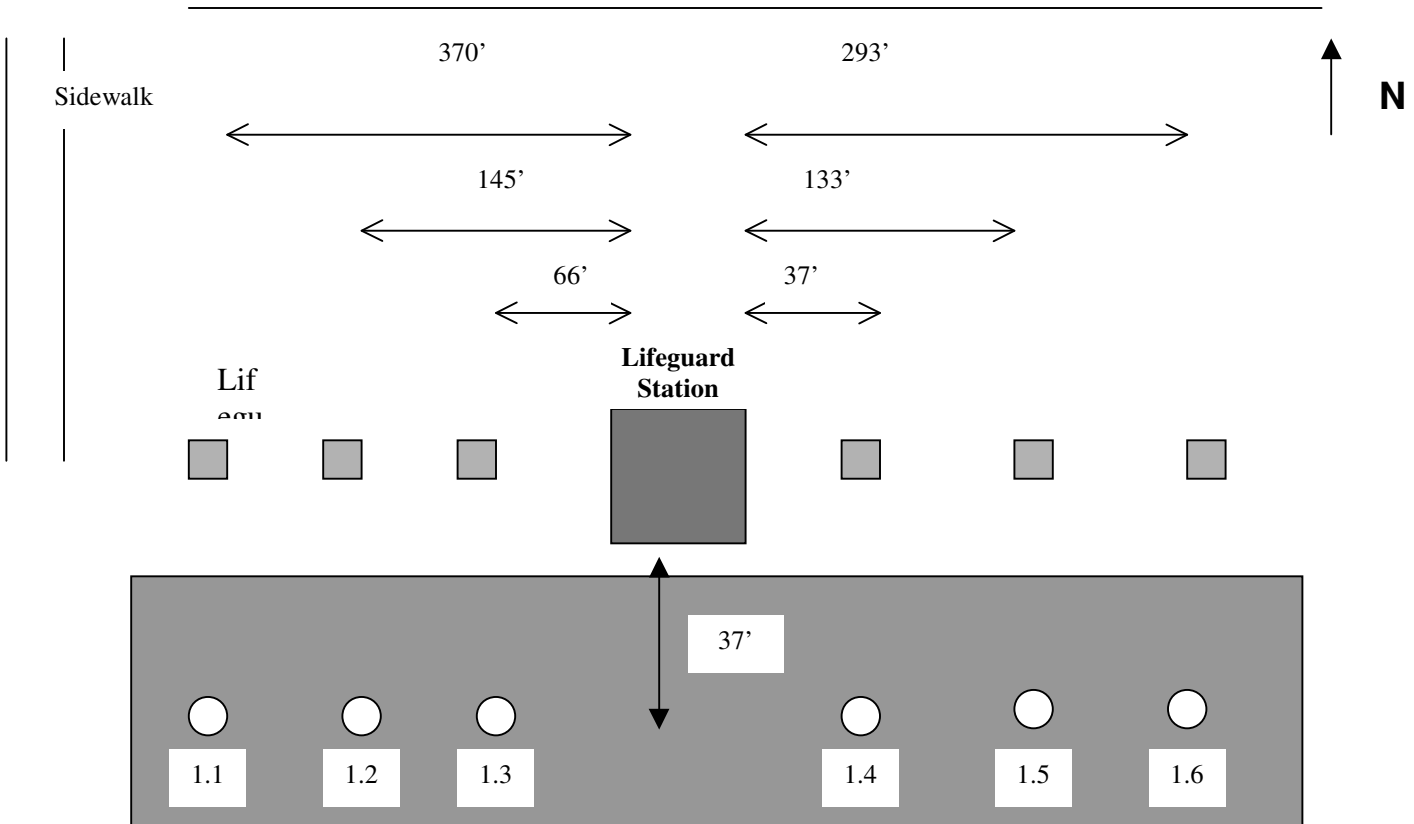
R 325.2103 Determination and closing of beaches.

Rule 3. (1) When, in the judgment of a health officer having jurisdiction, an evaluation of information provided by sanitary survey and bacteriological, biologic, chemical, or physical data provides evidence that a bathing beach may be detrimental to the health or safety of the bathers or swimmers, it shall be determined to be unsafe.

(2) If voluntary closure of a bathing beach cannot be accomplished, the health officer shall take action as provided by section 12541 of the act.

Sample Point Measurements

Chair to sample point	37 feet
<u>1.1</u> Lifeguard station to sample point (west)	370 feet
<u>1.2</u> Lifeguard station to sample point (west)	145 feet
<u>1.3</u> Lifeguard station to sample point (west)	66 feet
<u>1.4</u> Lifeguard station to sample point (east)	37 feet
<u>1.5</u> Lifeguard station to sample point (east)	133 feet
<u>1.6</u> Lifeguard station to sample point (east)	293 feet



BEACH SAMPLING

Collection Date _____

Collected By _____

LABORATORY RESULTS

Sample No.	Location	Sample Source	E. Coli	Time	H20°F
1.1	HCMA Metropark	B			
1.2	HCMA Metropark	B			
1.3	HCMA Metropark	B			
1.4	HCMA Metropark	B			
1.5	HCMA Metropark	B			
1.6	HCMA Metropark	B			
2.1	SCS Memorial Park	B			
2.2	SCS Memorial Park	B			
2.3	SCS Memorial Park	B			
3.1	SCS Civic Center	B			
3.2	SCS Civic Center	B			
3.3	SCS Civic Center	B			
4.1	New Baltimore Park	B			
4.2	New Baltimore Park	B			
4.3	New Baltimore Park	B			
41	DNR	R			
42	Spillway	D			

SAMPLE METEOROLOGICAL DATA

B=Beach

S=Stream

R=River L=Lake D=Drain

Wind Direction From _____

Lab Examiner _____

Water Temperature _____

Beginning: _____

Date _____

Last Rainfall _____

Ending: _____

BEACH SAMPLING

Appendix C, cont.

Collection Date _____

Collected By _____

LABORATORY RESULTS

Sample No.	Location	Sample Source	E. Coli	Time	H20°F
6.1	Four Bears Water - North Beach	B			
6.2	Four Bears Water - North Beach	B			
6.3	Four Bears Water - North Beach	B			
7.1	Four Bears Water - South Beach	B			
7.2	Four Bears Water - South Beach	B			
7.3	Four Bears Water - South Beach	B			
8.1	HCMA Stoney Creek – Eastwood	B			
8.2	HCMA Stoney Creek – Eastwood	B			
8.3	HCMA Stoney Creek – Eastwood	B			
9.1	HCMA Stoney Creek – Baypoint	B			
9.2	HCMA Stoney Creek – Baypoint	B			
9.3	HCMA Stoney Creek – Baypoint	B			

SAMPLE METEOROLOGICAL DATA

B=Beach

S=Stream

R=River L=Lake D=Drain

Wind Direction From _____

Lab Examiner _____

Water Temperature _____

Beginning: _____

Date _____

Last Rainfall _____

Ending: _____

Macomb County Health Department

Beach Sampling Data

Appendix D

Water Body: Lake St. Clair

Sample Location/Description: Metropolitan Beach

Date	Time	Daily Beach Ecoli Geo	Beach 30 Day Ecoli Geo	Water Temp	Wind Dir	Wet/Dry
04/17/2000	10:05:00 AM	10.00	0.00	48	E	04/11/2000
04/19/2000	10:10:00 AM	100.58	0.00	51	W	04/11/2000
04/24/2000	9:35:00 AM	33.43	0.00	50	O	04/21/2000
04/26/2000	9:30:00 AM	2.80	0.00	50	O	04/21/2000
05/01/2000	9:30:00 AM	29.24	0.00	55	W	05/01/2000
05/03/2000	9:15:00 AM	3.98	0.00	56	W	05/01/2000
05/08/2000	10:06:00 AM	57.91	0.00	60	NW	05/01/2000
05/10/2000	8:55:00 AM	2,265.08	0.00	60	N	05/09/2000
05/15/2000	11:05:00 AM	36.29	33.42	61	NW	05/10/2000
05/17/2000	9:05:00 AM	29.68	37.72	59	SE	05/16/2000
05/22/2000	10:20:00 AM	76.52	36.59	60	S	05/19/2000
05/24/2000	9:50:00 AM	20.59	34.67	64	S	05/23/2000
05/31/2000	10:05:00 AM	33.40	48.29	64	SW	05/28/2000
06/05/2000	10:06:00 AM	14.60	56.81	65	NE	06/04/2000
06/07/2000	10:05:00 AM	5.08	41.91	63	SW	06/05/2000
06/12/2000	10:05:00 AM	6.91	20.32	70	SW	06/11/2000
06/14/2000	10:05:00 AM	51.44	21.23	71	S	06/13/2000
06/19/2000	9:50:00 AM	10.88	18.72	68	SW	06/18/2000
06/21/2000	10:05:00 AM	230.55	21.49	73	S	06/21/2000
06/26/2000	10:05:00 AM	482.79	31.88	76	SW	06/24/2000
06/27/2000	12:50:00 PM	13.09	28.88	73	SW	06/26/2000
06/28/2000	10:05:00 AM	10.44	26.08	74	S	06/26/2000
07/03/2000	10:06:00 AM	36.33	26.30	73	SE	06/29/2000
07/05/2000	10:05:00 AM	9.47	25.19	75	NE	06/29/2000
07/10/2000	10:06:00 AM	22.43	29.22	74	NE	07/09/2000
07/12/2000	10:06:00 AM	81.52	37.40	71	E	07/10/2000
07/17/2000	9:05:00 AM	89.55	39.53	74	SW	07/14/2000
07/19/2000	10:05:00 AM	6.94	37.80	71	N	07/15/2000
07/24/2000	10:06:00 AM	32.44	31.06	71	SE	07/15/2000
07/26/2000	10:35:00 AM	7.31	20.43	72	E	07/15/2000
07/31/2000	10:06:00 AM	25.85	23.74	73	SE	07/31/2000
08/02/2000	10:06:00 AM	11.51	20.90	74	SW	08/02/2000
08/07/2000	10:05:00 AM	15.01	22.00	73	SW	08/06/2000
08/09/2000	10:05:00 AM	8.95	19.86	77	SW	08/06/2000
08/14/2000	10:35:00 AM	32.97	17.96	76	SW	08/13/2000
08/15/2000	10:35:00 AM	22.84	18.40	75	SW	08/14/2000
08/16/2000	10:20:00 AM	11.61	15.00	76	SW	08/14/2000

17-Apr-01 02:06 PM

Page 1 of 2

08/21/2000	10:15:00 AM	38.23	17.79	68	NW	08/14/2000
08/23/2000	10:06:00 AM	5.48	14.89	72	N	08/23/2000
08/28/2000	10:05:00 AM	4.34	14.13	72	E	08/26/2000
08/30/2000	10:05:00 AM	13.09	13.20	74	N	08/27/2000
09/06/2000	9:15:00 AM	6.13	12.14	62	E	08/22/2000
09/11/2000	10:40:00 AM	29.35	13.85	73	SW	09/10/2000
09/13/2000	9:36:00 AM	10.06	12.14	70	NW	09/13/2000
09/18/2000	9:32:00 AM	4.59	9.99	65	SE	09/13/2000
09/20/2000	9:06:00 AM	83.13	11.01	64	S	09/13/2000
09/25/2000	9:50:00 AM	19.38	12.89	58	NW	09/23/2000

Summary for Metropolitan Beach

Date	Daily Beach Ecoli Geo Mean	Beach 30 Day Ecoli Geo
04/17/2000	10.00	0.00
04/19/2000	100.58	0.00
04/24/2000	33.43	0.00
04/26/2000	2.80	0.00
05/01/2000	29.24	0.00
05/03/2000	3.98	0.00
05/08/2000	57.91	0.00
05/10/2000	2,265.08	0.00
05/15/2000	36.29	33.42
05/17/2000	29.68	37.72
05/22/2000	76.52	36.59
05/24/2000	20.59	34.67
05/31/2000	33.40	48.29
06/05/2000	14.60	56.81
06/07/2000	5.08	41.91
06/12/2000	6.91	20.32
06/14/2000	51.44	21.23
06/19/2000	10.88	18.72
06/21/2000	230.55	21.49
06/26/2000	482.79	31.88
06/27/2000	13.09	28.88
06/28/2000	10.44	26.08
07/03/2000	36.33	26.30
07/05/2000	9.47	25.19
07/10/2000	22.43	29.22
07/12/2000	81.52	37.40
07/17/2000	89.55	39.53
07/19/2000	6.94	37.80
07/24/2000	32.44	31.06
07/26/2000	7.31	20.43
07/31/2000	25.85	23.74
08/02/2000	11.51	20.90
08/07/2000	15.01	22.00
08/09/2000	8.95	19.86
08/14/2000	32.97	17.96
08/15/2000	22.84	18.40
08/16/2000	11.61	15.00
08/21/2000	38.23	17.79
08/23/2000	5.48	14.89
08/28/2000	4.34	14.13
08/30/2000	13.09	13.20
09/06/2000	6.13	12.14
09/11/2000	29.35	13.85
09/13/2000	10.06	12.14
09/18/2000	4.59	9.99
09/20/2000	83.13	11.01
09/25/2000	19.38	12.89

Results of the most recent bathing water sample collection is listed above.

- () This beach is currently in compliance with the total body contact standard.
- () This beach is currently in non-compliance with the total body contact standard.
 - () The daily geometric mean of the most recent samples collected exceeds the total body contact standard of 300 E. Coli per 100 ml.
 - () The daily geometric mean of all samples collected over the last 30 days exceeds the total body contact standard of 130 E. Coli per 100 ml.

Prepared by:

Reviewed by:

May 1, 2001

City Of St. Clair Shores
Parks and Recreation Department
20000 Stephens
St. Clair Shores, MI, 48080

Subject: Blossom Heath Beach

Dear Beach Operator:

The bacteriological results from the August 23, 2000, water sampling event at your bathing beach have been received by this department. Analysis of this data alone and collectively with data from preceding sampling events has revealed a violation of the surface water total body contact standards. The specific violation(s) is/are checked below:

- (☒) The geometric mean of the samples collected during the above-mentioned sampling event is 1052.15 E. coli per 100 ml, which exceeds the total body contact standard of 300 E. coli per 100 ml.
- (☐) The geometric mean of all samples collected over the last 30 days is _____ E. coli per 100 ml, which exceeds the total body contact standard of 130 E. coli per 100 ml.

You are hereby ordered to immediately close the bathing beach specified above until further notice. Macomb County Health Department staff will continue monitoring, and you will be notified of the results and when normal beach operations may resume.

If you have any questions, please contact this department at (810) 469-5236.

Sincerely,

Stephen A. Lichota
Supervisor
Environmental Health Services Division

May 1, 2001

City Of St. Clair Shores
Parks and Recreation Department
20000 Stephens
St. Clair Shores, Mi, 48080

Subject: **Blossom Heath**

Dear Beach Operator:

Continued monitoring of the bathing beach specified above has shown that the water quality conditions which necessitated closure of the beach on August 24, 2000, have improved and are now in compliance with total body contact standards.

You may resume normal beach operations at this time. If there are any questions, please feel free to contact this department at (810) 469-5236.

Sincerely,

Stephen A. Lichota
Supervisor
Environmental Health Services Division

MACOMB COUNTY BATHING BEACH CLOSURE DATES (1994-present)

Metro Beach

1994- 6/1-6/4; 6/22-7/30; 8/2-8/12; 8/13-8/16; 8/20-8/26; 8/29-8/30
1995- 7/7-7/8
1996- 7/19-7/21
1997- 5/30-6/3; 6/13-6/15; 6/27-7/11; 7/23-7/25; 8/8-8/10; 8/13-end of season (9/1)
1998- 7/28-7/30; 8/4-8/8
1999- NONE
2000- 6/25-6/28; 8/14-8/16

Blossom Heath

1994- 6/29-7/19; 7/25-7/31; 8/1-8/11; 8/14-8/18; 8/22-8/23
1995- 6/30-7/3; 7/7-7/13; 8/4-8/5; 8/6-8/7; 8/11-8/16; 8/19-8/20; 8/22-8/23; 8/25-end of season (9/4)
1996- 6/5-6/7; 6/19-7/12; 7/17-8/28
1997- 8/22-8/27
1998- 7/23-7/25; 8/18-8/20
1999- 6/15-6/17; 7/20-7/22; 7/27-7/29
2000- 6/6-6/8; 6/13-7/25; 8/1-8/3; 8/24-8/29

Memorial Park

1994- 6/29-7/20; 7/25-7/27; 8/6-8/8; 8/9-8/23
1995- 6/30-7/2; 7/18-7/25; 8/4-8/5; 8/6-end of season (9/4)
1996- 5/29-8/21
1997- 6/4-6/6; 6/18-6/20; 7/4-8/6; 8/13-8/15
1998- 6/2-6/9; 6/11-6/16; 6/23-6/25; 7/23-7/25
1999- 6/15-6/17; 7/1-7/3
2000- 6/25-6/27; 7/13-7/14; 7/27-8/16

New Baltimore

1994- 6/29-7/5
1995- NONE
1996- 6/19-6/26
1997- NONE
1998- NONE
1999- 8/26-8/28
2000- 8/1-8/2; 8/3-8/4

Four Bears - North

1994- 7/16-7/21; 8/17-8/24
1995- 6/5-6/7, 7/3-7/10
1996- 6/21-6/23, 7/2-7/3
1997- 7/30-8/1
1998- 6/4-6/6
1999- 6/15-6/17
2000- 6/15-6/16; 6/29-6/30; 7/4-7/8; 7/11-7/13; 8/3-8/10

Four Bears - South

1994- 6/22-7/8
1995- 7/2-7/3
1996- 8/1-8/2
1997- NONE
1998- 6/30-7/2; 7/9-7/14; 7/21-7/23; 7/28-7/30; 8/11-8/13

Stony Creek - Eastwood

1994- 8/3-8/4; 8/17-8/18
1995- 7/2-7/3
1996- NONE
1997- NONE
1998- NONE
1999- NONE
2000- 8/1-8/2

Stony Creek - Baypoint

1994- 8/3-8/4; 8/10-8/12
1995- 6/30-7/3
1996- NONE
1997- NONE
1998- NONE
1999- NONE
2000- 8/3-8/4

Appendix I: *Macomb County Health Department Web Page Beach Closings and Beach Testing Data* can be viewed at the following address:

http://libcoop.net/mchd/sum_beach.html

MACOMB COUNTY HEALTH DEPARTMENT
ENVIRONMENTAL HEALTH SERVICES DIVISION
SURFACE WATER IMPROVEMENT AND MONITORING PROGRAM

CONTINGENCY SAMPLING PROCEDURES

1. Bathing beaches are routinely monitored twice weekly on Mondays and Wednesdays. However, under certain conditions an additional sampling event will be conducted on Fridays to determine if a closed beach can reopen.
2. The conditions that determine whether a sample event will take place on a Friday are as follows:
 - a. When the water quality at a particular beach is in non-compliance with the daily geometric mean standard, but is in compliance with the 30-day geometric mean standard, based on the Wednesday sampling event.
 - b. When the water quality at the beach is in non-compliance with the 30-day geometric standard, the two previous consecutive sample events indicate daily geometric means less than 130 E.coli/100 ml, and an additional sample event would have the potential to lower the 30-day geometric mean into compliance.
3. Discuss Wednesday sample results with the program Associate Director or, in his absence, the program Supervisor. If it is determined that Friday sampling is necessary, the Associate Director or Supervisor will notify the on-call management staff member and the Martha T. Berry Laboratory.
4. Collect the samples as early as feasible on Friday morning. Ascertain from laboratory staff when the sample results will be read on Saturday and arrange with the on-call management staff member to meet at that time for access to the building. Review sample results with management staff member and enter data into computer database.
5. Review generated report(s) with recalculated geometric means and notify bathing beach operator(s) of results by FAX and telephone. Update data on internet website.
6. The on-call management staff member will contact department administrative staff, i.e., Thomas Kalkofen and/or Steve Gold, to report results.



Macomb County Health Department
Environmental Health Services Division
43525 Elizabeth Road
Mt. Clemens, Michigan 48043
(810) 469-5236

www.libcoop.net/mchd

Please contact the above office or our Internet site for additional information:

- Bathing Beach Monitoring
- Surface Water Improvement and Monitoring
 - Household Hazardous Waste Disposal
 - Pesticide Disposal
 - Mercury Disposal
- Onsite Sewage Disposal and Drinking Water Supply
 - Community Health and Safety
 - Food Protection